# Alternate-row treatment with the repellent methiocarb to protect cherry orchards from birds

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ABSTRACT. An alternate-row treatment of the bird repellent methiocarb (CA chemical name 3, 5-dimethyl-4-(methylthio)phenyl methylcarbamate; Mesurol®) was evaluated for protecting entire cherry orchards from damage by European starlings, American robins, house finches, common grackles and other birds. Half of each orchard was randomly selected for treatment with methiocarb (1·7 kg/ha) applied to trees in every other row. The other half of each orchard was used as a control. Estimated loss of cherries to birds at the time of damage assessment was significantly lower in the six partially sprayed blocks (6·5%) than in the six unsprayed, control blocks (8·8%) ($P = 0·03$). However, the level of bird damage and the magnitude of the reduction were insufficient to provide a favourable benefit:cost ratio: there was a return of only $0·80 in cherries saved for every $1·00 spent on application and chemical costs. The overall lower damage in the partially sprayed blocks appeared to result primarily from reduced feeding by birds in the sprayed trees, which averaged 4·6% loss compared with 8·4% loss for unsprayed trees within the same block ($P = 0·22$). That this difference was not statistically significant indicates that birds had to sample a substantial number of berries before discriminating between sprayed and unsprayed fruit. It is not clear how birds detected berries sprayed with the repellent. Suggestions for evaluating other partial treatments of bird repellents in cherry orchards are discussed.

KEYWORDS: Bird damage; cherry orchards; chemical repellents; methiocarb; partial treatment

## Introduction

Bird depredations on ripening fruit crops in North America result in major economic losses (Mott and Stone, 1973; Stone, 1973; Crase *et al.*, 1976). Regulations that restrict the use of lethal control measures, together with the ineffectiveness of most non-lethal frightening devices, have prompted a continuing interest in the use of non-lethal chemical repellents as a means of deterring birds (Griffin and Baumgartner, 1959; Luckwill and Weaver, 1964; Rogers, 1978; Tobin and Crabb, 1985).

During the past 15 years particular attention has focused on methiocarb [IUPAC chemical name 4-methylthio-3,5-xylyl methylcarbamate; CA chemical name 3,5-dimethyl-4-(methylthio)phenol methylcarbamate], a broad-spectrum insecticide marketed as Mesurol that has bird-repellent properties (Schafer and Brunton, 1971; Guarino, 1972; Crase and DeHaven, 1976). This carbamate compound is a cholinesterase inhibitor (Schlagbauer and Schlagbauer, 1972) that produces conditioned food aversions in birds (Rogers, 1974; Conover, 1984). Numerous tests have demonstrated methiocarb's effectiveness in reducing bird depredations to ripening cherries (Tobin and Dolbeer, 1987; DeHaven *et al.*, 1979) blueberries (Stone, Shake and Langowski, 1974; Conover, 1985) and grapes (Bailey and Smith, 1979; Hothem *et al.*, 1981).

In spite of the demonstrated effectiveness of methiocarb, both economic and regulatory pressures are compelling growers to reduce their use of this repellent. At rates currently recommended on the United States Environmental Protection Agency (EPA) registration label, growers must spend about $99·00/ha in chemical costs alone for a single application of 2·2 kg Mesurol 75% WP in cherries or blueberries. Another potential problem is chemical residues remaining on crops at harvest: during 1986, EPA reduced the residue tolerance limits for methiocarb and its active metabolites on cherries and blueberries from 25 ppm to 5 ppm (EPA, 1987). Clearly, there are growing pressures for orchardists to make more efficient use of this repellent.

Alternative methods of application may reduce chemical requirements and allow for more cost-effective use of methiocarb. Tests with captive birds suggest that the concept of mimicry could provide a

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basis for protecting crops by spraying only some of the susceptible plants in a field or orchard (Mason and Reidinger, 1983; Avery, 1985). Decreased use of methiocarb may be possible where birds cannot discriminate between repellent-treated 'model' and untreated 'mimic' portions of a crop. In such situations, birds might reduce their feeding on both rather than suffer the noxious postingestive effects associated with the repellent (Conover, 1984; Avery, 1985; Tobin, 1985a). To our knowledge the concept of mimicry has not been tested in an agricultural situation. The objective of this study was to attempt protection of entire blocks of cherry trees from bird damage by spraying only alternate rows of trees with methiocarb.

## Methods

The study was conducted during 1987 in six orchards in the mid-Hudson Valley of New York. Study sites varied from 0·7 to 1·3 ha, with each orchard containing a mixture of varieties. Four sites contained a majority of sweet cherry trees with a few interplanted tart cherry trees. The remaining two sites contained exclusively tart cherries.

One-half of each site was randomly selected for a single alternate-row treatment with Mesurol 75% WP at the rate of 2·2 kg/ha (1·7 kg methiocarb/ha) of treated trees. Treatment and control blocks were adjacent to each other at all sites except one where they were 150 m apart. Growers applied Mesurol with tractor-mounted airblast sprayers to both sides of trees in the rows selected for treatment as soon as possible after the first cherries turned red, 6–9 days before harvest. Applications were on 11 June for sweet cherries and from 1 to 3 July for tart cherries.

Bird damage was assessed on 20 randomly selected trees in each treatment and control block of an orchard 1–3 days before harvest began. The samples from the partially sprayed blocks were stratified so that an equal number of sprayed and unsprayed trees were selected. Where treatment and control blocks were contiguous, either the two rows or the two trees within each row that were on the border with the adjacent block were excluded from the sample. For each tree, two directions (either north and south, or east and west) were randomly selected, and two samples were taken from opposite sides in the upper half of the tree. For each sample, a main branch was followed away from the trunk to a branching point beyond which there were approximately 50 cherries or empty stems. A person then climbed a ladder and counted the number of (1) cherries pecked but not totally removed by birds, (2) empty stems and (3) undamaged cherries, while another person recorded the damage. Because fruit which fail to develop because of lack of fertilization, embryo abortion, insect infestation, or other physical damage generally abscise with the pedicel attached (Bukovac, 1971), pedicels remaining on trees but without pits were assumed to be the result of bird damge.

Bird usage of the blocks was evaluated by conducting bird counts at each orchard on 3 days during the period from 1–3 days after application of Mesurol to 1–4 days before assessment of damage. During each count, an observer watched with binoculars the treated and control blocks each for 15 min, with the order in which the blocks were watched determined randomly for each count. The observer recorded the numbers and species of birds flying into the block across one or more borders, depending on the main access routes used by the birds. For each orchard, the same number of borders and approximately equal lengths of margin were observed for the two blocks. At the end of the 30 min count, the observer slowly walked down one row selected at random in each block and recorded all birds heard or seen in the block.

A paired comparison $t$ test was used to evaluate mean difference in bird damage between the two treatments (unsprayed control blocks and partially sprayed blocks) in each of the six orchards. A paired comparison $t$ test also was used to evaluate mean difference in damage between sprayed and unsprayed trees in the partially sprayed blocks. The damage data were transformed using an arcsine square root transformation on the percentage of cherries pecked or removed. Wilcoxon's signed rank test was used to evaluate differences in the number of birds flying into the partially sprayed and control blocks.

## Results

The six orchards averaged 7 days between the application of Mesurol and the assessment of damage (*Table 1*). Overall estimated loss of cherries to birds at the time of damage assessment was 7·7%, of which 3·3% was due to pecking and 4·4% was due to removal of entire cherries. These are minimum estimates of loss because additional feeding by birds undoubtedly occurred before harvest was completed. Sweet cherry orchards in New York contain a mixture of varieties that are interplanted for pollination purposes, and 2 weeks or more may elapse between the harvest of the earliest and latest varieties. The amount of additional loss later-maturing varieties sustained between the time of our assessment and their harvest is unknown.

Mean loss in the unsprayed blocks was 8·8%, compared with 6·5% loss in the partially sprayed blocks ($P = 0·03$) (*Table 1*). The overall lower damage in the partially sprayed blocks appeared to be attributable primarily to reduced feeding by birds in the sprayed trees. Sprayed trees averaged 4·6% loss compared with 8·4% loss for unsprayed trees (*Table 1*); however, this difference was not statistically significant ($P = 0·22$).

Rain may have washed some of the methiocarb residues off the fruit, but in all likelihood did not contribute to the lack of a significant difference

TABLE 1. Mean percentage of cherries damaged (pecked or removed) by birds in orchard blocks with alternate-row application of Mesurol and in blocks with no application of Mesurol

| Orchard | Days from application to assessment | Cherries damaged by birds (%) | | | |
|---|---|---|---|---|---|
| | | Partially sprayed block | | | Unsprayed block |
| | | Treated rows | Untreated rows | Total block | Total block |
| 1 | 8 | 14·3 | 14·7 | 14·5 | 14·2 |
| 2 | 7 | 0·5 | 2·1 | 1·3 | 2·6 |
| 3 | 5 | 2·7 | 3·2 | 3·0 | 5·8 |
| 4 | 5 | 3·4 | 8·5 | 5·9 | 11·1 |
| 5 | 8 | 4·5 | 3·9 | 4·2 | 6·1 |
| 6 | 9 | 2·2 | 18·2 | 10·1 | 12·9 |
| Mean | 7 | 4·6[a] | 8·4[a] | 6·5[b] | 8·8[b] |

[a]Mean percentage damage was not significantly ($P = 0·22$) different between the treated rows and untreated rows in the partially sprayed blocks, paired comparison $t$ test ($t = 1·39$, 5 d.f.); [b]mean percentage damage was significantly ($P = 0·03$) different between the partially sprayed and unsprayed blocks, paired comparison $t$ test ($t = 2·86$, 5 d.f.).

TABLE 2. Mean number of birds flying into blocks of trees with alternate rows sprayed with methiocarb and into adjacent unsprayed blocks during 15 min observation periods per block at each of six cherry orchards

| Treatment | No. of observations | European starling | American robin | House finch | Common grackle | All others[a] | Total |
|---|---|---|---|---|---|---|---|
| Partially sprayed | 18 | 5·7 | 3·0 | 1·7 | 2·5 | 3·3 | 16·2[b] |
| Unsprayed | 18 | 10·8 | 5·1 | 2·9 | 3·7 | 3·6 | 26·1[b] |

[a]Other species included mourning dove (*Zenaida macroura*), gray catbird (*Dumetella carolinensis*), northern mockingbird (*Mimus polyglottus*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), red-winged blackbird (*Agelaius phoeniceus*), goldfinch (*Carduelis* spp.), and brown-headed cowbird (*Molothrus ater*); [b]significantly ($P < 0·05$) different, Wilcoxon's signed rank test.

between sprayed and unsprayed trees within the treated blocks; <5 mm precipitation was recorded between application of the repellent and assessment of damage in the sweet cherry orchards. In the tart cherry orchards (orchards 2 and 4, *Table 1*), where as much as 38 mm of rain fell during the study, damage reduction on the sprayed trees was none the less relatively large.

An average of 16 birds was observed flying into the partially sprayed blocks per 15 min observation period, compared with an average of 26 birds per 15 min observation period for the unsprayed blocks ($P < 0·05$) (*Table 2*). European starlings (*Sturnus vulgaris*), American robins (*Turdus migratorius*), house finches (*Carpodacus mexicanus*), and common grackles (*Quiscalus quiscula*) were the most commonly recorded species.

Although overall loss in the partially sprayed blocks was significantly reduced compared with losses in the unsprayed blocks, the overall level of bird damage and the magnitude of the reduction were not substantial enough to provide a favourable benefit: cost ratio for chemical application. Applying 2·2 kg Mesurol/ha to every other row of cherry trees costs approximately $40·00/ha for labour, equipment and fuel (M. Castaldi, Cornell University Cooperative Extension Service, personal communication) and $49·00/ha for the chemical. In 1987, growers in New York received an average of $0·92/kg of sweet cherries, with a mean yield of 3363 kg/ha (P. F. Bascomm, New York Agricultural Statistics Service, personal communication). The 26% reduction in bird damage on the partially treated blocks represents 2·3% of the mean yield in the state. This reduction resulted in increased yields worth an average of $71·00/ha, a return of only $0·80 for every $1·00 spent on application and chemical costs.

## Discussion

The alternate-row treatment we employed in this study reduced bird damage in entire partially sprayed blocks compared with adjacent unsprayed blocks, although the reduction was not sufficient to pay for the cost of the chemical application. Conover (1985), in field tests in ripening blueberry fields, concluded that Mesurol averted birds only from treated plants. This may have occurred in our study also, as sprayed trees had only about one-half the loss (4·6%) of unsprayed trees (8·4%) in the partially sprayed blocks. However, these differences were not significantly ($P = 0·22$) different. Dolbeer, Ingram and Stickley (1973) compared intermixed plots (0·08 ha) of blueberries and also found slightly lower, but statistically insignificant, reductions in bird damage due to methiocarb. Bailey and Smith (1979) used a border treatment of methiocarb to reduce Eurasian blackbird (*Turdus merula*) depredations in Australian

grape vineyards. However, the birds in this study roosted in adjacent citrus orchards and concentrated most of their feeding in the parts of the orchards that were sprayed.

The percentage of cherries damaged by birds was 45% less on sprayed trees than on unsprayed trees within the same block (*Table 1*), suggesting that birds somehow detected which trees were sprayed. That this difference was not statistically significant indicates that birds had to sample a substantial number of cherries before discriminating. If some birds did reduce their feeding from sprayed trees, it is not clear what sensory cue they used to make this distinction. Tests with captive birds have shown that visual (methiocarb treatments leave a white film on the surface of the fruit) and gustatory cues do not have a major role with birds encountering methiocarb on food (Grant, 1978; Avery, 1984; Rooke, 1984; Tobin, 1985a,b). Birds in this study may have sampled cherries, internally evaluated whether they were sprayed (i.e. suffered the adverse consequences of ingesting methiocarb), and then concentrated their feeding on unsprayed trees.

Several modifications may improve the efficacy of partial treatments of Mesurol for protecting cherry orchards. The large number of unsprayed trees in our treatment blocks, together with the proximity of the unsprayed control blocks, provided an opportunity for rapid extinction of any conditioning that may have occurred. Spraying a greater proportion of trees in the treatment blocks would increase the ratio of models to mimics, and thus might increase the risk to birds feeding in the orchard (Avery, 1985). Increasing the spatial separation of the treated and control blocks also might effectively increase the ratio of mimics to models, although the absence of a control unsprayed block nearby might have the opposite effect and impel birds to intensify their feeding in the treated blocks. Choosing models differently might also increase efficacy. An alternate-row treatment was used in this study to facilitate using a tractor-mounted sprayer to apply the repellent. Randomly selecting trees for treatment might make it more difficult for birds to distinguish between treated and untreated trees. Another strategy is to spray only early ripening varieties in an attempt to deter birds before they establish a habit of feeding in the orchard.

In conclusion, we feel that the results of this experiment are sufficiently positive to warrant the evaluation of other partial-treatment regimens for protecting ripening cherries from bird damage.

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